COLORADO FOREST RESTORATION INSTITUTE
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Forsythe II Prescribed Fire:
Unit 38C Post-Burn Monitoring Summary

Overview

Forsythe II is a fuels reduction project on approximately 19,000 acres of national, county, and private land within the Boulder Ranger District of the Arapaho and Roosevelt National Forests and Pawnee National Grassland (ARP) in Boulder and Gilpin Counties (Table 1; Figure 1). This project includes mechanical and manual vegetation removal, broadcast prescribed burning, and defensible space mitigation on private land. In April 2023, the ARP Boulder Ranger District conducted the first stage of prescribed burning of 945 total acres identified in the Environmental Assessment, and additional prescribed burns were conducted in April 2024. Prior to prescribed burning, some areas were manually treated to alter fuel structure in 2015 and 2019; slash from these manual treatments was lopped and scattered throughout the burn units. The Colorado Forest Restoration Institute (CFRI) established monitoring plots in unit 38C (burned in 2023/2024) to track changes in forest structure and composition, woody fuels, and understory plants. This report summarizes immediate post-burn fire effects. This monitoring was part of a larger monitoring project for the Forests to Faucets program, a partnership between the US Forest Service, Denver Water, Colorado State Forest Service, Natural Resources Conservation Service, and CFRI, where forest treatments were implemented with the goal of reducing wildfire risk to watersheds and improving forest conditions across the Colorado Front Range.

Goals and Objectives

The Forsythe II project is strategically located to protect values within the Wildland Urban Interface (WUI) in Boulder and Gilpin Counties, as well as Gross Reservoir, a critical resource to Denver's water supply. The overall project goals are:

1. Reduce the severity and intensity of wildfire in the WUI.
2. Restore ponderosa pine/mixed conifer stands, aspen and meadows/shrublands towards their characteristic species composition, structure, and spatial patterns to increase resistance and resiliency to future natural disturbances.

The objectives of the prescribed burns are:

1. Reduce understory vegetation (ladder fuels) up to 75% across the project area.
2. Allow up to 25% mortality of the overstory across the entire broadcast unit.
3. Limit canopy scorch heights to 30 feet or less in conifer trees greater than 14 inches DBH.

Table 1. Forsythe II project information.

Ownership	U.S. Forest Service
Funding	Forests to Faucets
Forest Type	Dry mixed conifer
Year Completed	2023, 2024
Implementation Method	Prescribed fire (2023, 2024)
Acres Treated	43.4 (2023), 58.5 (2024)
Acres Monitored	101.9 (broadcast burn)
Years Monitored	2021 (pre-burn), 2023-2024 (post-burn)

Methods

CFRI worked with the ARP to establish 11 permanent plots for pre- and post-treatment monitoring, 9 of which burned and are summarized in this report (Figure 1). Fire effects data was collected within 1 to 2 months of prescribed burn entries in 2023 and 2024. Fire effects on the forest floor were classified at each burned plot from 12 subplots within a 1/10th acre area. A complete description of CFRI's field data collection methods can be found in the Immediate Post-Burn Mothership Plot Protocol (CFRI 2009).

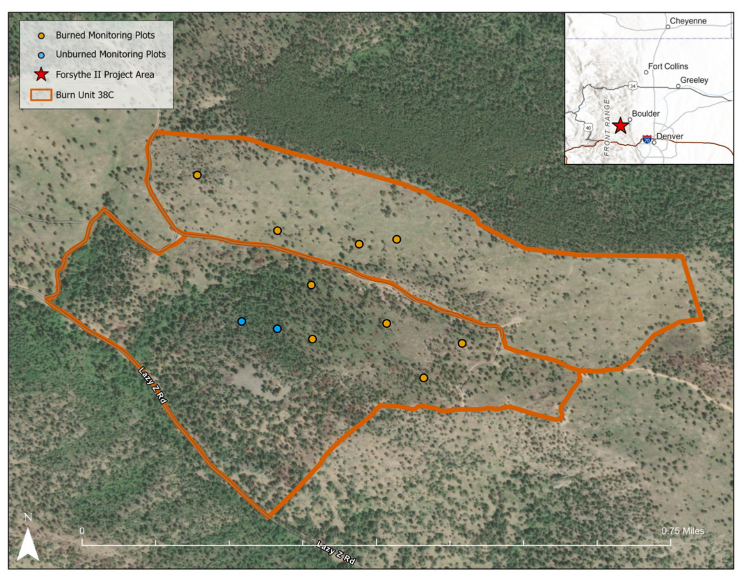

Figure 1. Map of Unit 38C, part of the larger Forsythe II project area, located near Gross Reservoir in between Boulder and Nederland, CO. This unit experienced prescribed burning in 2023 and 2024. Eleven monitoring plots were established by the Colorado Forest Restoration Institute; nine of these plots (orange circles) experienced prescribed burning in 2023 and 2024 and were monitored for initial prescribed burn fire effects immediately following burning.

Highlights

The effects of the Forsythe II prescribed fire were highly variable; within monitoring plots in unit 38C, prescribed fire effects were light and patchy. Plots were located in areas that experienced low burn severity. A map of burn severity based on satellite imagery shows Unit 38C burned predominantly at low severity with small areas of moderate and high severity (Figure 2). Two of the four completed burn units within the Forsythe II project area contain a higher proportion of moderate severity fire, though these units are not captured in the field data presented here. The unburned areas within the fire perimeter could be due to snow prior to the burn that resulted in higher fine dead fuel moisture. The monitoring plots captured low severity and patchy fire spread, resulting in little recorded change in surface fuels, ladder fuels, or tree canopy base height.

Across all subplots, 62% of burnable substrate (e.g., dead surface fuels) remained unburned (Figure 3). Just over 20% of burnable substrate and vegetation, were scorched or lightly burned, indicating that these areas had experienced fire, but generally with low severity and with patchy coverage (Figure 3). Consequently, there were no significant changes in fine woody surface fuels or litter and duff loading between pre-fire and post-fire conditions (Figure 4).

Throughout the burn unit, ladder fuels were relatively unchanged. Average sapling crown scorch was 7% with a maximum of 31%, indicating no sapling mortality is likely (Figure 5). Maximum char height on mature trees was on average 4 feet; the Forsythe II burn in unit 38C did not create flame lengths tall enough to have a substantial impact on tree canopy base height (Figure 5). Given the low percentage of sapling crown scorch and relatively short char heights, it can be concluded that the Forsythe II burn had very little impact on vertical continuity of fuels within the 38C unit.

During the spring 2024 prescribed burn, ARP fire staff ignited the entire 38C unit, including the area that burned the previous spring. Even though the 2023 burn was light and patchy, in 2024 the prescribed fire did not carry across

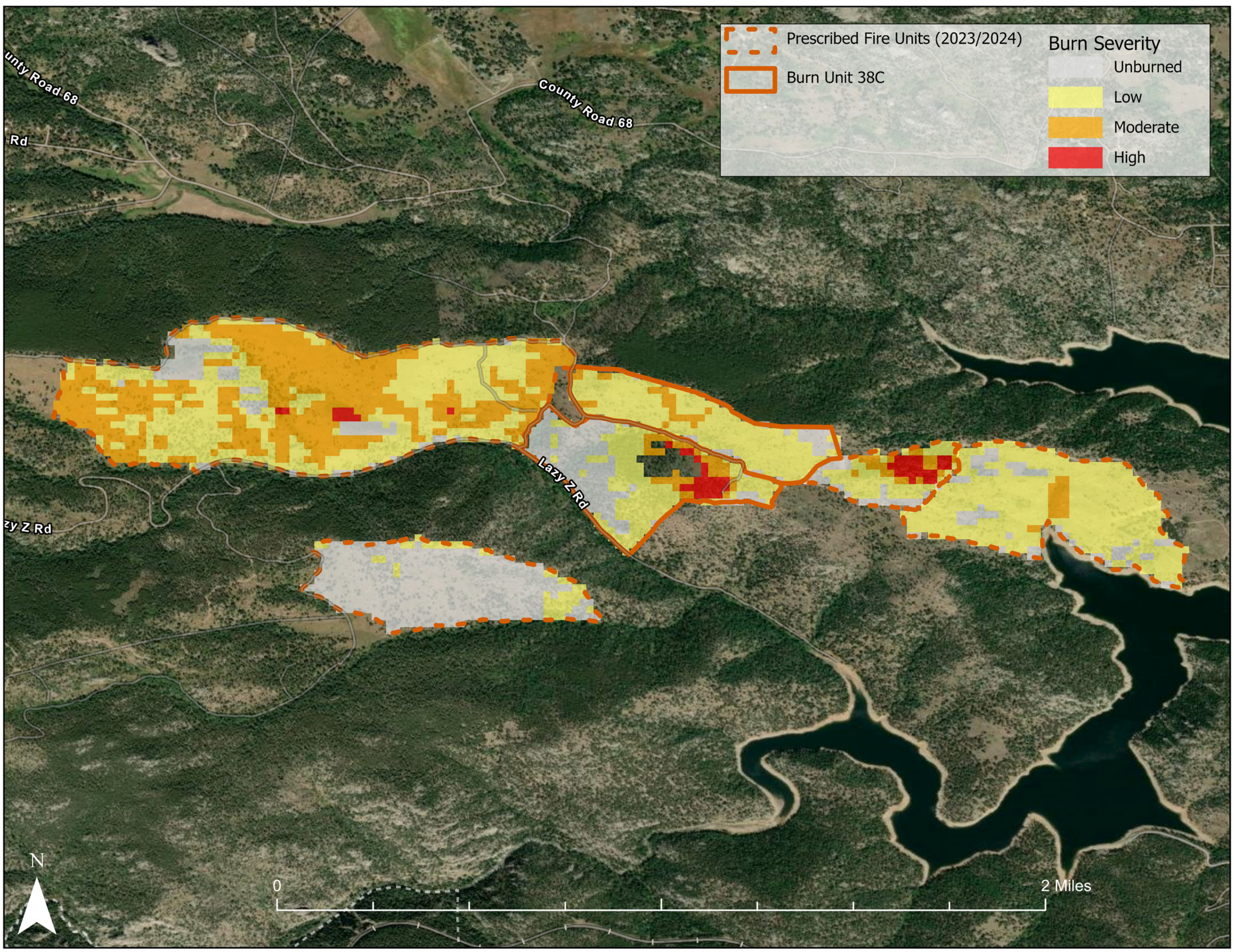

Figure 2. Map of burn severity across the Forsythe II prescribed burn units. The burn severity map was calculated using aerial imagery to determine the difference in Normalized Burn Ratio within 30m pixels (dNBR; Key and Benson 2006). Gaps in burn severity classification within Unit 38C are due to aerial imagery error or cloud coverage. Variability in burn severity illustrates the variable severity and patchiness of the prescribed burn effects.

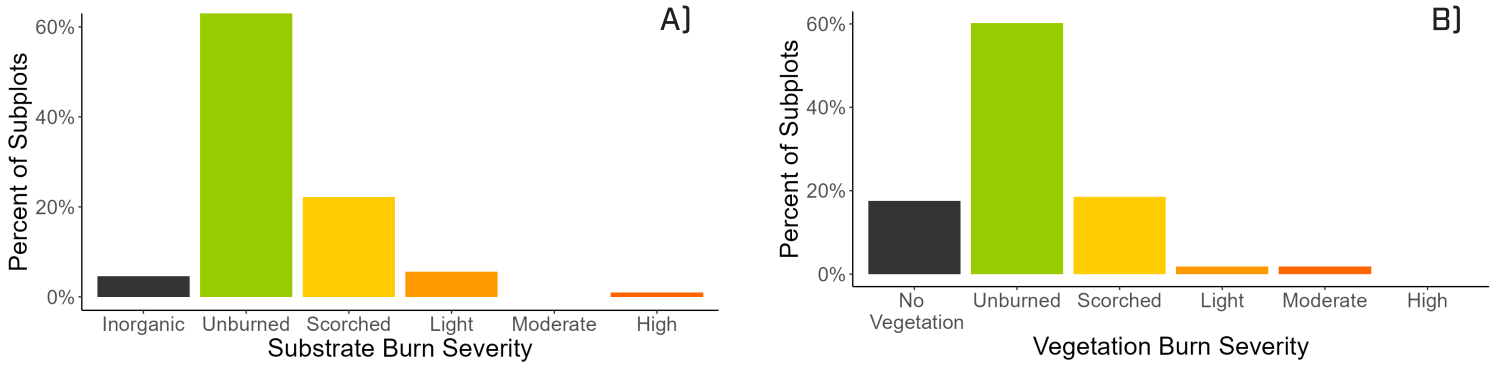

Figure 3. Burn severity across monitoring plots showing the majority of subplots were unburned or scorched. Subplots recorded both A) substrate (e.g., litter rock, soil, etc.) and B) vegetation, which included grasses, forbs, and shrubs.

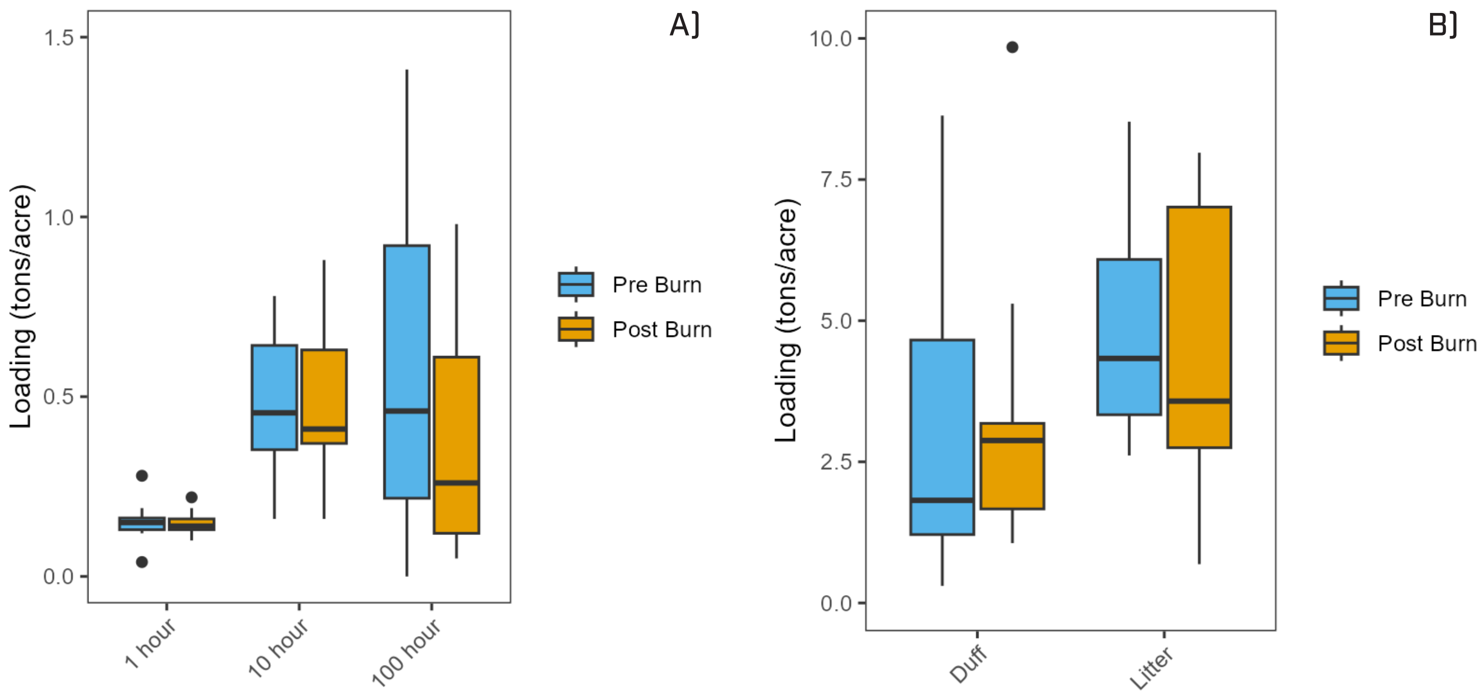

Figure 4. Pre- and post-burn fuel loading for surface and ground fuels. Figure 4A illustrates fuel loading for fine wood (e.g., 1-, 10-, and 100-hour fuels), and Figure 4B illustrates loading of litter and duff.

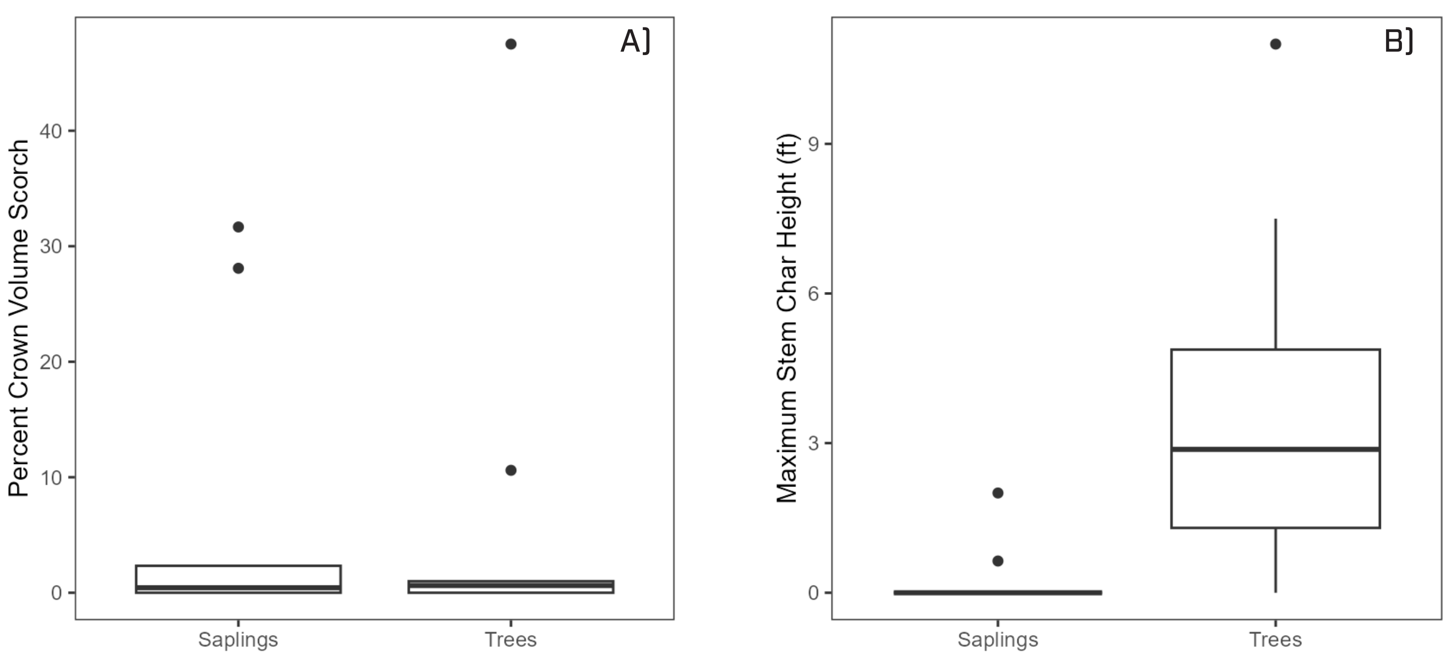

Figure 5. Crown volume scorch (%) on saplings and mature trees (A) and maximum stem char height (ft) on saplings and mature trees (B). All trees and saplings monitored had less than 50% crown volume scorch, and the majority had less than 5%, indicating little to no fire-induced tree mortality. Figure B demonstrates relatively low stem char heights compared to the height of a mature tree. Given both low sapling mortality and low stem char heights, the assumed impact of the Forsythe II burn on vertical fuels, or ladder fuels, is negligible.

most of the previously burned area. Again, high relative humidities and moisture events contributed to a very low severity burn and patchy spread within unit 38C in both years (Figure 3, Figure 6).

Aerial imagery analysis from other prescribed burns units implemented in the Forsythe II project that were not monitored by CFRI show larger areas of moderate fire severity, in contrast to the mostly low severity or unburned areas within the monitored unit 38C (Figure 2, Figure 3). Prescribed fire effects depend largely on the weather and fuel moisture conditions at the time of the burn. It can be challenging to line up resource availability, smoke dispersion, fuel moisture and weather windows to achieve desired effects on fuels and trees. Given the goals of this project to reduce severity and intensity of wildfire and to increase resiliency of forests to future disturbances, managers may consider implementing future prescribed burns under drier conditions to create more significant changes in target metrics.

Next steps

The ARP Boulder Ranger District plans to continue prescribed burning within the Forsythe II project area into 2025. CFRI field crews will continue to monitor and collect data on established plots 1- and 5-years post-burn to monitor additional changes in trees, woody fuels, and understory plants.

References

Colorado Forest Restoration Institute. (2020). Immediate Post-Burn Mothership Plot Protocol: Field Data Collection to Assess Immediate Post-Burn Vegetation and Fuel Characteristics. CFRI-2009. https://cfri.colostate.edu/wp-content/uploads/sites/22/2022/05/RxMothership-Immediate-Postburn-Protocol-2020.pdf.

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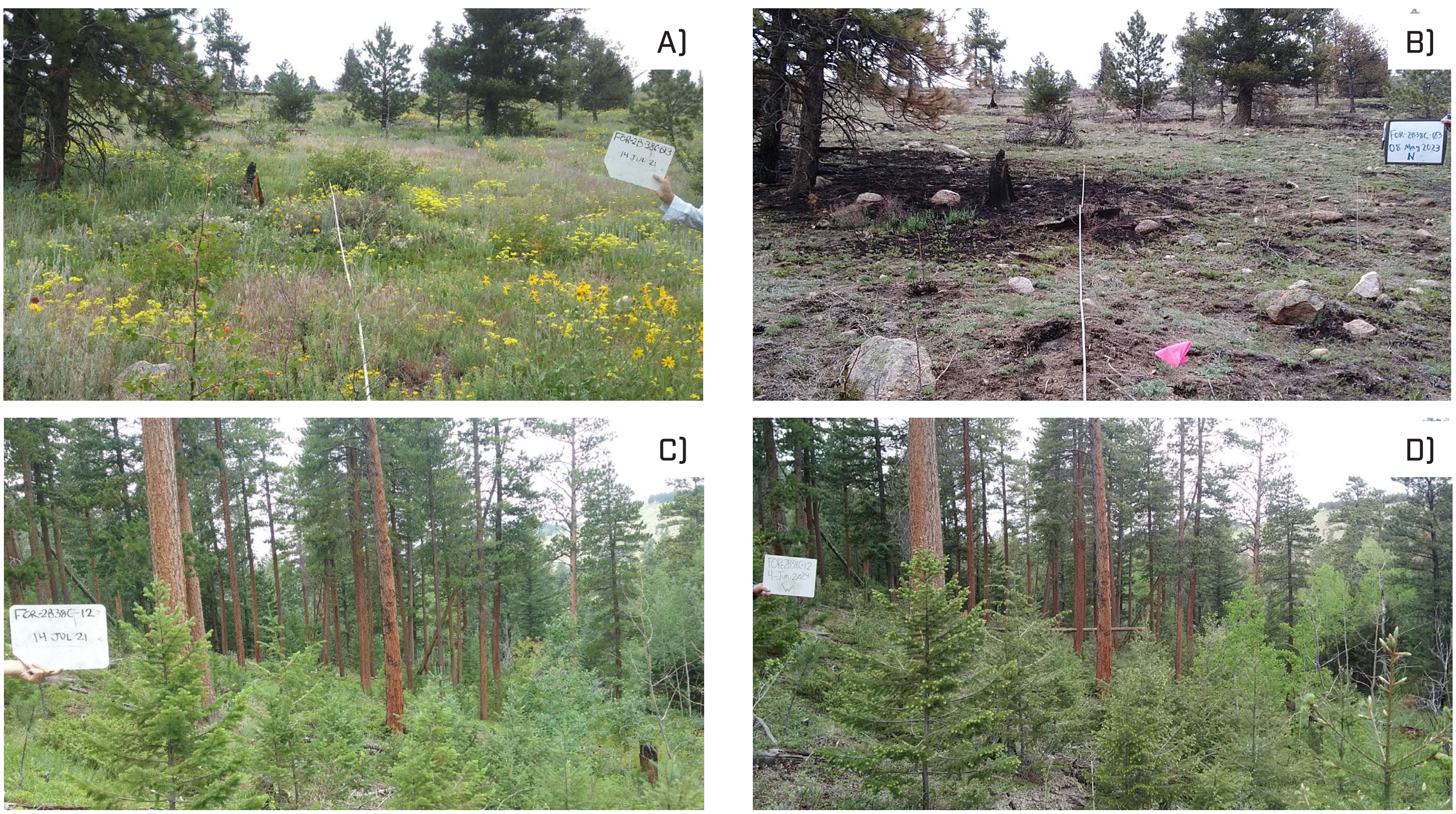

Figure 6. Photos pairs (A & B and C & D), showing pre-fire conditions (A and C) vs. post-fire conditions (B and D) in two different locations within Forsythe II Unit 38C. While the open meadow plot in photos A & B saw a higher degree of evidence of prescribed burn effects (e.g., scorching and litter/wood consumption), a closed canopy plot in photos C & D saw little change in ladder fuels and little visible evidence of scorching. These photos illustrate the variable severity and patchiness of the prescribed burn in Forsythe Unit 38C in 2023 and 2024.

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